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Impacts of Two Different Locations on the Growth, Proximate and Mineral Compositions of *Celosia Argentea* and *Amaranthus Cruentus*

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ABSTRACT

Background: Qualities and quantities of plants especially vegetables are determined by several factors. One of these factors is location.

Aim: This study is aimed at determining the impacts of two different locations on the growth, proximate and mineral compositions of *Celosia argentea* and *Amaranthus cruentus*.

Materials and Methods: Matures seeds were obtained from Lagos State Agricultural Input Supply, Agric Bus-Stop in Ojo-Lagos, Nigeria. Nursery were made and the seeds were sown in two different locations (LASU campus and Officers Village); and the seedlings was transplanted after 14days for establishment and morpho-metric data were collected at the 3 and 4 weeks after transplants (WAT). Proximate and mineral analyses were done using Standard Analytical procedure. All the data collected were analyzed.

Results: Morphological data collected revealed that *C. argentea* and *A. cruentus* seedlings grown in LASU campus were leafier and taller than those in Officers Village. Also, Proximate and mineral analyses revealed there was variation in proximate and mineral compositions of both *C. argentea* and *A. cruentus*. Although, the studied vegetables contains appreciable nutrients required by the body. This variation was attributed to differences in soil properties such soil water, soil minerals, soil microorganisms and soon.

Conclusion: It is therefore concluded that various soil factors have varying impacts on the growth, proximate and mineral compositions of *C. argentea and A. cruentus* from locations to locations. The farmers when updated with this would know that good site selection based on scientific analysis of the soil will help to establish their *vegetable* farm in a desirable field.

KEYWORDS: Location, growth, proximate and mineral compositions, *Celosia argentea*, *Amaranthus cruentus*

I. INTRODUCTION

Population explosion of the world and its food demand has overwhelmed the available land resources especially in Lagos, Nigeria. With the decrease in plant based foods and other alternatives, many have considered vegetable as the cheapest source of nutrients [1]. Vegetables are very rich sources of essential nutrients such as carbohydrates, carotene, protein, vitamins, calcium, iron and so on. Vegetables are fresh and edible portions of herbaceous plants, which can be eaten raw or cooked [2]. Vegetables contain valuable food ingredients which can be successfully utilized to build up and repair the body. Vegetables are valuable in maintaining alkaline reserve of the body [3]. Vegetables may be edible roots, stems, leaves, fruits, or seeds and each contributes to diet in its own way [4].

Most of the commonly eaten vegetables are the succulent leaves of plants; they are eaten as supplementary foods, side dishes or in soup as condiments, or eaten with other main dishes [5]. Leafy vegetables are regular ingredients in the diet of the average home in most tropical countries of Africa. These vegetables are valuable and cheap sources of important food types especially in rural areas where they contribute substantial quantities of proteins, minerals, vitamins, fibers and oils which are usually in short supply in daily menus [6]. In Nigeria, different types of leafy vegetables are eaten singly or in combinations by different ethnic groups and they have been reported to contain ingredients which are useful in building up and repairing body tissues [7]. In rural areas of most developing countries, where poverty and natural disaster wreak havoc, the majority of the populace still depends heavily on starchy food as main sources of energy and protein thereby leading to the prevalence of protein deficiency amongst the people [8].

Furthermore, minerals cannot be produced by human and farm animals and as such they must eat mineral rich plants including leafy vegetables and water [9]. Vegetables also serve as buffers for acidic compounds produced during food digestion [10].

Commonly eaten among these vegetables in Nigeria are *Amaranthus cruentus* and *Celosia argentea. A. cruentus* is a fast growing vigorous erect annual plant that belongs to the family *Amaranthaceae* [6]. The plant can grow up to 2m and is often cultivated in home gardens as leafy vegetables in Nigeria. It grows best in areas where annual daytime temperatures are within the range of 22-28ºC; it is usually grown from seeds as half-hardy annual plant but stem cuttings is inevitable [2, 4]. *A. cruentus* prefers a well-drained fertile soil with a pH within range of 5.5-7.0 [11]. It can grow in virtually all types of soils but best in soil with more organic matters [12, 13]. In traditional medicine, the leaves are employed as laxatives, tapeworm expellant and anti-tumor.

Celosia argentea L is an erect annual herb belonging to the family *Amaranthaceae*. It grows to a height of about 2m with ridge and glabrous stem. The leaves are alternate, simple and without stipules [14]. The leaves and tender stems are cooked in soups, sauces or stews with various ingredients including other vegetables such as onions, pepper and tomatoes with fish or meat and palm oil. The new inflorescences are also used as potherb [15]. In Kenya, the Masia use the liquid extract from the leaves and flowers as body wash for convalescents; the whole plant is used as an antidote for snake bite and roots to treat gonorrhea and eczema while in Ethiopia, the flowers are used to treat dysentery and muscles troubles, the seeds for treating diarrhea. Also, *C. argentea* are rich in protein, vitamin A and C, calcium and iron which are more in harvested plants between 5-7weeks after planting [16-18]. More so, they are composed of some phyto-chemicals such as anthocyanin, betalain, betaxanthins and so on.

However, qualities and quantities of plants especially vegetables are determined by several factors. These factors include biotic and abiotic factors among many others. Biotic factors include pests, diseases and so on; while abiotic factors include water, soil types, soil depth, and many others [13, 19, 20]. However, summarily, some of these factors could be aptly put under *location.* Location of the plant during growth and development determines majorly the plants' compositions. Onwordi *et al.* [7] and Oluwole *et al.* [13] reported that mineral elements in vegetables are a function of their concentrations in the soil in which the vegetables are planted.

Hence, locations determine the properties of soil in different places and this may leads to different compositions of the soil nutrients [13, 21, 22] and this could lead to varying chemical constituents of the same plants grown on it. Environmental conditions in different areas could contribute to varying soil properties and varying compositions of the plants.

The essence of this study was to determine the effects of two locations on the growth, proximate and mineral composition of two important and commonly consumed leafy vegetables viz: *A. cruentus* and *C. artengea* in relation to locations.

II. MATERIALS AND METHODS

Collection of Plant Materials

Mature seeds of *Celosia argentea and Amaranthus cruentus* were obtained from Lagos State Agricultural Input Supply, Agric Bus-Stop, Ojo- Lagos State; and the two leafy vegetables (*A. cruentus* and *C. argentea*) were freshly harvested from local farms in two different locations in Lagos (Lagos State University (LASU) Campus and Officers Village in Ojo Military Cantonment in Ojo Local Government area, Lagos State, Nigeria). Soil analysis was done on the soil samples at Kappa Biotechnology Laboratory at Bodija, Oyo State, Nigeria and the soil compositions determined (Tables 1).

Table 1: Soil Analysis of Soil samples used

Parameters	Officers Village	LASU Campus
Porosity	34.02	32.75
pH	7.69	6.68
Moisture content (%)	1.80	1.80
Conductivity (µS/cm)	88.60	77.00
Total-Nitrogen(mg/Kg)	34.09	30.02
Total Organic Carbon (%)	32.00	33.30
Total organic matter (%)	62.70	59.60
PO^{-}_{4} (mg/Kg)	45.81	37.61
Ca^{++} (mg/ Kg)	32.19	40.12
Mg^{++} (mg/ Kg)	66.74	89.15
Fe^{++} (mg/ Kg)	23.70	26.99
Cu^{++} (mg/ Kg)	0.09	0.60
Pb^{++} (mg/ Kg)	0.07	0.60
Hg^{++} (mg/Kg)	0.02	0.02
Cd^{++} (mg/Kg)	0.25	0.01
Zn^{++} (mg/Kg)	1.30	1.50
Ni^{++} (mg/Kg)	0.08	0.60
As^{++} (mg/Kg)	0.03	0.09
Total-Petroleum Hydrocarbon (mg/Kg)	2.80	2.60

Soil Preparation and Nursery

Two small beds (3-2Ft) were made and the viable mature seeds of *Celocia argentea and Amaranthus cruentus* sown on each bed after been respectively watered. The seeds emerged after the second and third days for *Celocia argentea and Amaranthus cruentus* respectively. The beds were water daily with light irrigation to avoid waterlogging. After 14 days of emergence, the seedlings are ready for transplant.

Seedling Transplant and Growth Experiment

Two long beds (10-5Ft) were made and equal seedlings of *Celosia argentea and Amaranthus cruentus* were transplanted respectively. The seedlings were watered twice daily. After three weeks in which *C. argentea and A. cruentus* have been transplanted, five (5) samples each were carefully and randomly removed for morphological (numbers of leaf, stem girth and stem height) measurements and laboratory mineral and proximate analyses. The same procedure was repeated for the fourth week after transplant.

Processing of Plant Materials

The fresh leaves of the vegetables were thoroughly and separately washed with deionized distilled water. Afterwards, they were dried in the oven by exposing the leaves to a constant temperature at 45°C for 3-4 days. The leaves were then grounded into fine powder using dried pestle and mortar.

Proximate Analysis

The proximate analysis for the leafy vegetable samples for moisture, ash, crude fibre and fat were carried out following the standard methods of AOAC [23]. Nitrogen was determined by micro-kjeldahi method as described by Pearson [24] and the percentage nitrogen was converted to crude protein by multiplying by 6.25. Carbohydrate was determined by difference. All findings were performed in triplicates.

Mineral Analysis

The mineral constituents of the leafy vegetable samples were analysed using the solution obtained by dry ashing the samples at 550°C and dissolving the ash in distilled deionized water in flask. All the minerals were analysed using atomic absorption spectrophotometer (Analyst Perkin Elmer Model 200A).

Statistical Analysis

The quantitative data collected were subjected to mean± standard deviation using MS excel 2007 version. All the data collected were in triplicates.

III. RESULTS AND DISCUSSION

Effects of locations on the morphological characters of Celosia argentea and Amaranthus cruentus

In this study, the effects of different locations on the morphological characters of *Celosia argentea* and *Amaranthus cruentus* showed a significant variation in growth performance. Thus, Table 2 showed that *Celosia argentea* grown in LASU campus had better morphological responses in terms of stem height, numbers of leaves and stem girth than those other seedlings grown in Officers Village. Similarly, the results of morphological characters of *Amaranthus cruentus* seedlings grown in LASU campus had better performance compared to those grown I Officers Village (Table 3). Also, this means that the *Celosia argentea* and *Amaranthus cruentus* cultivated at LASU campus is leafier compared to those seedlings cultivated in Officers Village, (Figures 2 and 3). The difference observed in the growth of the two vegetables could be attributed to differences in soil properties (Table 1). The results confirmed the finding of Odiaka [25], when it reported that the *Telfairia occidentalis* grown in clayey soil were less healthy and stayed considerably shorter in height, root length, shoot length and leaf areas compared to those grown in humus and loam soil respectively. The finding also agreed with work of Oluwole *et al*. [20] when they reported variation in the growth pattern of *Telfairia occidentalis* grown on different soil types. This result further agreed with findings of Hwang *et al.*[26]. They reported that soil types have some impacts on plant growth; thus, promoting microorganisms found in the root region, increase plant nutrients and water uptake efficiencies, and production of plant hormones. It also affects plants' shoot and root biomass, nutrient uptake efficiencies, and plant chemical contents. However, this is to say that people that consumes these vegetables from LASU campus has more palatable portion compared to Officers Village.

Table 2: Morphological Parameters of *Celosia argentea*

Parameters / **Location**		**Height (cm)**		**Numbers of leaves**		**Stem girth (cm)**	
Officers Village		3WAT	4WAT	3WAT	4WAT	3WAT	4WAT
	Mean ±SD	42.80±5.33	57.80±7.53	19.80±3.50	25.80±4.90	1.20±0.74	1.50±0.51
	Range	30-60	40-70	15-30	20-35	0.8-1.50	1.00-3.00
LASU Campus	Mean ±SD	43.40±7.60	58.60±7.53	29.20±5.44	37.50±4.90	1.22±0.71	1.60±0.19
	Range	30.0-55.0	40.0-70.0	20.0-35.0	25.7-25.9	0.80-2.50	1.80-2.00

WAS- weeks after transplant; SD-Standard deviation

Table 3: Morphological Parameters of *Amaranthus cruentus*

Parameters / Location		Height (cm)		Numbers of leaves		Stem girth (cm)	
Officers Village		3WAT	4WAT	3WAT	4WAT	3WAT	4WAT
	Mean ±SD	46.30±2.33	55.40±7.53	22.80±3.50	33.50±2.40	1.20±0.44	1.50±0.57
	Range	35.0-65.00	45.0-70.00	21.0-30.00	20.0-38.00	0.8-1.50	1.00-3.00
LASU Campus	Mean ±SD	44.70±4.20	58.60±4.53	32.20±5.44	40.80±3.40	1.30±0.61	1.60±0.24
	Range	35.0-65.00	45.0-75.00	28.0-45.00	29.7-30.90	0.80-2.50	1.80-2.80

WAS- weeks after transplant; SD-Standard deviation

Effects of location on the proximate compositions of Celosia argentea and Amaranthus cruentus

In this study, the proximate analysis of *C. argentea* and *A. cruentus* showed a significant variation in relation to location of the plants. Thus, the moisture and ash contents of *C. argentea* in both Officers Village and LASU campus were similar (Table 4). While, Carbohydrate and fat contents of *C. argentea* seedlings grown in LASU campus were higher than those seedlings in Officers Village (Table 4). Crude fibre content of *C. argentea* cultivated in LASU campus was higher compared to those in Officers Village (Table 4). Similarly, the protein and ash contents of *A. cruentus* grown in Officers Village and LASU campus were close in compositions (table 5). While, the moisture and fibre contents of *A. cruentus* cultivated in LASU campus are higher than those seedlings grown in Officers Village (Table 5). Carbohydrate and fat contents of seedlings grown in Officers Village were higher compared to those grown in LASU campus (Table 5). These findings was supported by Oluwole *et al*. [13, 18-20], attributed these variation to abiotic factors such as water, soil mineralization, and so on within and around the locations.

More so, the percentage moisture contents of the analysed leafy vegetables revealed that *C. argentea* and *A. cruentus* contained approximately 3.78 and 5.11% respectively (Tables 4 and 5). These values were similar than those reported earlier for some Nigerian leafy vegetables by Onwordi *et al.* [7]; Oluwole *et al.* [13, 27]. *A. cruentus* harvested from Officers Village contained higher ash content (3.24%) when compared to those harvested from LASU campus; while, *Celosia argentea* harvested from both sites had similar ash contents (Tables 5 and4). The ash contents obtained are lower to those reported by Fagboun *et al*. [28] and Iheanacho and Ubebani [29]. Ash content is essential in foods as they account for the mineral constituents [30]. The crude protein contents of *A. cruentus* and *C. argentea* reported in this study (Tables 4 and 5) were lower compared to the protein contents of some leafy vegetables in other studies by Onwordi *et al.*[7], Asaolu *et al.*[31], Fagboun *et al.*[28] and Oluwole *et al.* [13, 27].

The crude fibre of the two investigated vegetables ranged from 11.41-28.26 % and 15.06-32.72 % in *A. cruentus* and *C. argentea* from locations respectively (Tables 5 and 4). The crude fibre content of *A. cruentus* particularly was higher than the reported values (8.50 – 20.90%) for some Nigerian vegetables [32]. Dietary fibre helps to lower cholesterol level, risk of coronary heart diseases, constipation and diabetes [33].

The carbohydrate content of *A. cruentus* (50.65 and 66.92% from both locations) was higher than that of *C. argentea* (46.37 and 62.62% from both locations) (Tables 5 and 4). These carbohydrate contents are above the 29.4%, 31.34%, 32.84% and 30.10% of *A. cruentus*, *Cochorus olitorius*, *A. argenta* and *O. gratissimum* respectively as reported by Onwordi *et al.* [7] and Oluwole *et al*. [13]; and also, the values was higher than the values reported for some leafy vegetables consumed in Nigeria which includes *Vernonia amygdalina* (8.65%), *O. gratissimum* (1.22%) and *Hibiscus sabdarifa* (15.79%) [31]. Carbohydrate constitutes a major class of organic compounds which are important for the maintenance of life and also provide raw materials for many industries [34]. The percentage fat content of the *A. cruentus* (0.55 and 1.23% from both locations) was lower than that of *C. argentea* (0.75 and 3.52% from both locations) respectively (Tables 5 and 4). These values are slightly higher than the fat content of some leafy vegetables commonly consumed in Nigeria, 0.45% in *A. cruentus*, 0.21% in *C. argenta* and 0.32% in *C. olitorius* as reported by Onwordi *et al.* [7] but to those reported Oluwole *et al.* [13, 27] and lower compared to some other vegetables consumed in West Africa [35]. The crude fat analysis shows that leafy vegetables contain low lipids and this confirms their importance as good diets for healthy life style.

Table 4: Proximate Composition (%) of *Celosia argentea*

Vegetable/Location	Moisture	Protein	Crude Fibre	` CHO	Fat	Ash
Officers Village						
Mean ± S.D	3.79 ± 0.04	13.61 ± 0.05	32.72 ± 0.09	46.37 ± 0.11	0.75 ± 0.08	2.71 ± 0.10
Range	3.75 - 3.98	14.30 –26.92	32.54 – 32.91	47.00 -50.54	0.76 – 0.80	2.68 – 2.74
LASU Campus						
Mean ± S.D	3.78 ± 0.14	12.14 ± 0.24	15.06 ± 0.55	62.62 ± 0.38	3.52 ± 0.11	2.87 ± 0.48
Range	3.74 -3.82	12.11 – 12.18	14.79 – 15.33	62.26 -62.98	3.45 – 3.60	2.81 – 2.93

SD = Standard deviation

Table 5: Proximate Composition (%) of *Amaranthus cruentus*

Vegetable/Location	Moisture	Protein	Crude Fibre	` CHO	Fat	Ash
OFFICERS VILLAGE						
Mean ± S.D	4.27 ± 0.12	12.91 ± 0.28	11.41 ± 0.25	66.92 ± 0.31	1.23 ± 0.16	3.24 ± 0.30
Range	4.22 - 4.33	12.88 –13.35	11.06 – 11.77	66.54 -68.31	1.20 – 1.26	3.20 – 3.28
LASU CAMPUS						
Mean ± S.D	5.11 ± 0.18	12.28 ± 0.50	28.26 ± 0.25	50.65 ± 0.10	0.55 ± 0.21	3.14 ± 0.14
Range	5.00 -5.23	12.20 – 12.37	28.00 – 28.53	50.43 -51.00	0.50 – 0.60	3.00 – 3.28

SD = Standard deviation

Effects of location on the Mineral compositions of *Celosia argentea* and *Amaranthus cruentus*

In this study, the proximate analysis of *C. argentea* and *A. cruentus* showed a significant variation in relation to location of the plants. From the aspect of the mineral content analysis, the mean value of iron (Fe) is higher both at 3rd and 4th week in LASU campus C. argentea compared to Officers Village; also, similar higher content was observed in A. cruentus for LASU campus (Tables 6 and 7). This finding agreed with the work of Javid *et al*. [36] and Asaolu *et al*. [31] reported for *A. esculentus* and *V. amygdalina.* Thus, Fe is an essential trace element for heamoglobin formation, oxidation of fat, protein and carbohydrate [37].

Magnesium (Mg) mean concentration value is higher at LASU campus *C. argentea* compared to Officers Village; Similar results higher content of Fe was also observed in *A. cruentus* for LASU campus (Tables 6 and 7). This finding concurs with the findings of Onwordi *et al*. [7]; Iheanacho and Udebuani [29] and Oluwole *et al.* [13, 27]. Thus, Mg is very important for heart function and has also been found to regulate and improve blood sugar.

Copper (Cu) mean concentration value is higher at Officers Village for *C. argentea* compared to those in LASU campus; Similar results of higher content of Fe was also observed in *A. cruentus* for Officers Village (Tables 6 and 7). This value is lower than those reported by Javid *et al*. [36] and Mohammed and Sharif [6]. More so, these results agree with the work of Ogundele *et al*. [38], when they undergo the assessment of heavy metal pollution of waste dumpsites in Kwara State using *Carica papaya*, *Musa spp*. and *Corchorus olitorius* as Indicators. The soil showed heavy metal contents below the threshold values reported in literature for agricultural soils, therefore establishing the suitability of the soil for planting [39].

Calcium (Ca), Phosphate (PO_4) and Nitrate (NO_3) is abundant in *Celosia argentea* and *Amaranthus cruentus* cultivated at Officers Village compared to one cultivated in LASU campus (Tables 6 and 7). Calcium has been reported to aid the growth and maintenance of bones, teeth and muscles [40]. Phosphorus is an important element for all forms of life, as phosphate (PO_4) makes up an important part of the structural framework that holds the DNA and RNA together. Nitrate ingestion is considered beneficial to human body as nitric oxides, is of the most important molecule in regulating blood pressure and maintaining vascular homeostasis.

Table 6: Mineral composition (mg/Kg) of *Celosia argentea*

Parameters / Locations		Fe		Mg		Ca		Cu		PO_4		NO_3	
		3WAT	**4WAT**	**3WAT**	**4WAT**	**3WAT**	**4WAT**	**3WAT**	**4WAT**	**3WAT**	**4WAT**	**3WAT**	**4WAT**
OFIICERS VILLAGE	Mean±SD	7.68±1.35	8.95±0.37	11.92±0.18	15.90±0.24	22.87±2.28	32.81±1.39	0.07±0.028	0.06±0.01	47.42±0.44	63.27±0.53	20.54±0.15	27.38±0.03
LASU CAMPUS	Mean±SD	11.52±0.064	15.37±0.085	24.85±0.071	33.10±0.57	22.38±0.21	29.84±0.28	0.35±0.014	0.45±0.00	37.78±0.31	50.37±0.36	20.18±0.35	26.76±0.25

WAS- weeks after Transplant; SD-Standard deviation

Table 7: Mineral composition (mg/Kg) of *Amaranthus cruentus*

Parameters / Locations		Fe		Mg		Ca		Cu		PO_4		NO_3	
		3WAT	**4WAT**	**3WAT**	**4WAT**	**3WAT**	**4WAT**	**3WAT**	**4WAT**	**3WAT**	**4WAT**	**3WAT**	**4WAT**
OFIICERS VILLAGE	Mean±SD	5.44±1.21	7.83±0.34	10.72±0.15	14.60±0.22	20.87±2.28	30.71±1.32	0.06±0.028	0.04±0.01	49.22±0.32	65.55±0.43	19.62±0.13	25.86±0.02
LASU CAMPUS	Mean±SD	10.62±0.044	12.74±0.056	22.55±0.031	30.40±0.53	26.33±0.15	32.54±0.22	0.31±0.011	0.40±0.00	40.68±0.21	46.35±0.31	21.13±0.32	27.56±0.23

WAS- weeks after Transplant; SD-Standard deviation.

IV. CONCLUSION

From the findings of this study, it could be concluded that various soil factors have varying impacts on the growth, proximate and mineral compositions of *Celosia argentea and Amaranthus cruentus* from locations to locations. The farmers when updated with this result would realised that good site selection based on scientific analysis of the soil will help in establishing their *vegetable* farm in a desirable field. Also, this would increase awareness on the consumers that location is signification in determining nutritional composition of any plant especially food crops.

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